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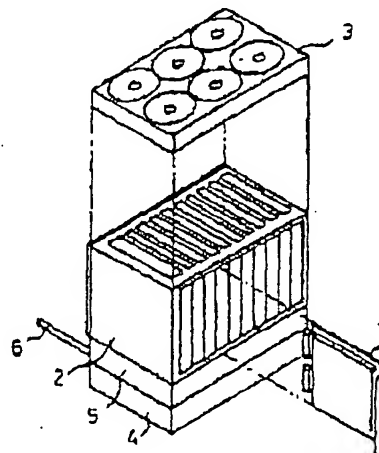
(54) 【発明の名称】 電子機器の冷却方式

(57) 【要約】

【目的】 単位体積当たりの発熱量の大きい高速デジタル電子機器の新規な冷却方式に関し、従来の強制対流による送風を大幅に変更することなく、更に効率的な冷却を行うことのできる冷却方式を提供する。

【構成】 電子機器(1)を収容した筐体(2)に設置されたファンユニット(3)によって、筐体の下部から外気を筐体内部に導入し、電子機器の発熱を冷却して粗まった空気を筐体上部から排出するように構成された強制対流による冷却方式において、筐体下部の外気導入経路に加熱ユニット(4)と加湿ユニット(5)を設け、導入される外気中に加湿された水分の蒸発によって相対湿度の許容範囲内で空気湿度を低下させることを特徴とする電子機器の冷却方式。

本発明の第1実施例の構成を示す斜視図



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(3)

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ら内部に取り入れると同時に、加熱ユニット4によってこれを環境温度の上限である30℃まで加熱する。次に加熱ユニット5によってこの空気中に水分を吸移すると、これが直ちに蒸発して湿度は30℃以下に低下し、同時に相対湿度は増加する。この場合、図4に示すような制御システムによって、湿度との関係において加熱ユニット5による水分の吸移量を制御して、上昇した相対湿度が環境温度の上限である60%を超えないようにすることが必要である。

【0011】このようにして、加熱によって環境温度の上限である30℃よりも低下した空気を使用して電子機器を冷却することにより、許容限界温度55℃の空気に対して約7.8kcal/kgのエンタルピーの差が得られ、従来の方式よりも約20%の冷却能力の上昇となる。更に、加熱のために静電気の発生並びに塵埃の発生も減少する付随効果も生じる。

【0012】空調機器の故障等のために、室内が環境温度の上限である30℃に既に到達している場合には、加熱ユニット4を作動させることなく、加熱のみを行う。すると、水分の蒸発によって空気温度が低下し、前述と同様に低温の空気を電子機器に送風することができる。図5(a)、(b)、(c)は本発明の他の実施例の構成を示す。

【0013】

【発明の効果】以上詳述したように、本発明によれば、空調設備による環境温度の限界以内で取り入れ空気に対して加熱と加湿を行うことにより、室内空気を再調整してより低温となし、以て許容限界温度までのエンタルピーの差を増大させたので、より効果的な電子機器の冷却を行うことが可能になる。

【図面の簡単な説明】

【図1】本発明の第1実施例の構成を示す斜視図である。

【図2】同じく側断面図である。

【図3】本発明の原理を示す空気線図である。

【図4】本発明の制御ブロック図である。

【図5】本発明の他の実施例の側断面図である。

【符号の説明】

- 1…電子回路パッケージ
- 2…筐体
- 3…ファンユニット
- 4…加熱ユニット
- 4a…ヒーター
- 6…加湿ユニット
- 5a…超音波加湿器
- 6…給水パイプ
- 7…センサー

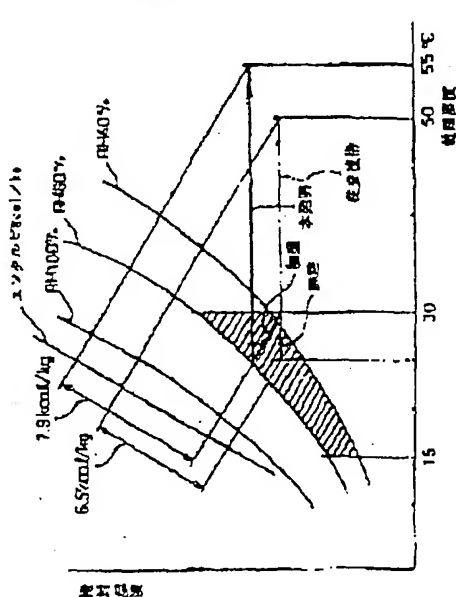
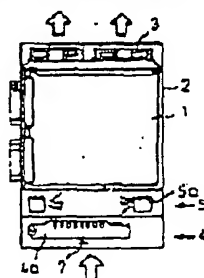
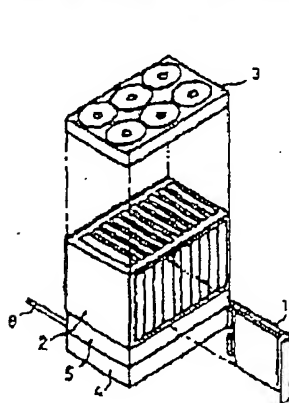
【図1】

【図2】

【図3】

本発明の第1実施例の構成を示す斜視図 本発明の第1実施例の側断面図

本発明の原理を示す空気線図



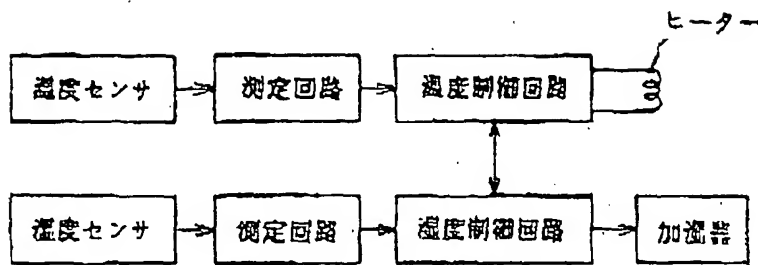
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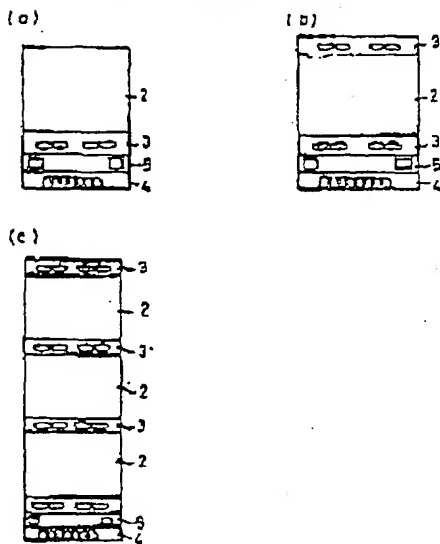
【図4】

本発明の制御ブロック図



【図5】

本発明の他の実施例の断面図



(4)

## PATENT ABSTRACTS OF JAPAN

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(21)Application number : 04-000208

(71)Applicant : FUJITSU LTD

(22)Date of filing : 06.01.1992

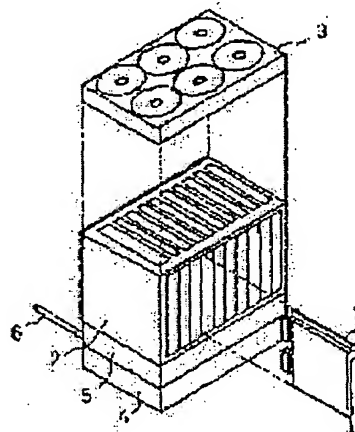
(72)Inventor : FUJITA SHUHEI

## (54) COOLING SYSTEM OF ELECTRONIC APPARATUS

## (57)Abstract:

PURPOSE: To enable effective cooling without largely changing installation of the conventional forced convection, regarding a new cooling system of high speed digital electronic apparatus wherein heat generation amount per unit volume is large.

CONSTITUTION: In a forced convection cooling system constituted in the manner in which, by a fan unit 3 arranged in a cabinet 2 containing electronic apparatus 1, the air is introduced from below the cabinet, and the air heated by absorbing the heat generated from the electronic apparatus is discharged from the upper part of the cabinet, a heating unit 4 and a moistening unit 5 are installed in an air introducing route in the lower part of the cabinet, and the air temperature is decreased within the allowable limit of relative humidity by the vaporization of water content sprayed in the introduced air, thereby constituting a cooling system of electronic apparatus.



## LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]


[Date of registration]

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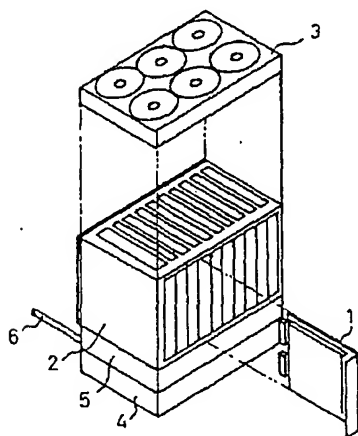
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
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本発明の第1実施例の構成を示す斜視図



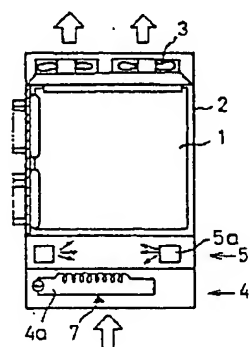
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本発明の第1実施例の側断面図

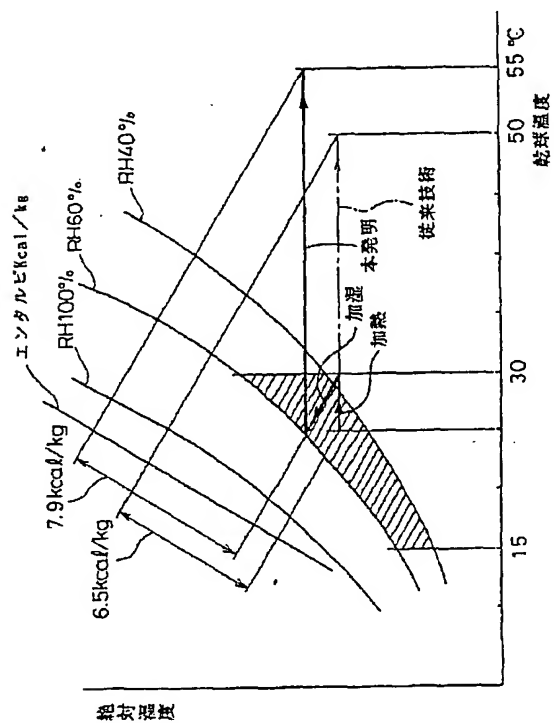


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Drawing selection drawing 3

本発明の原理を示す空気線図

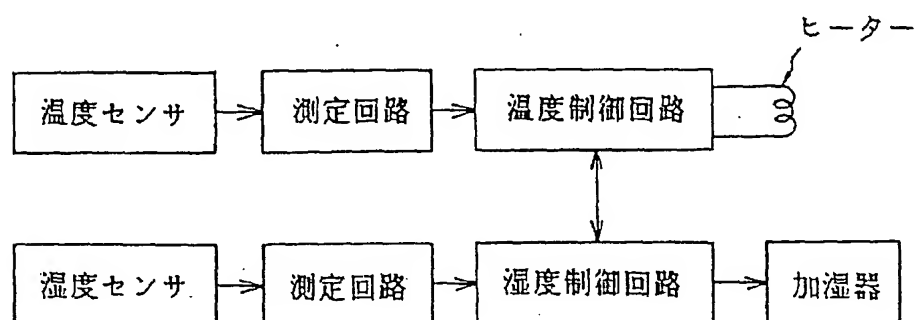


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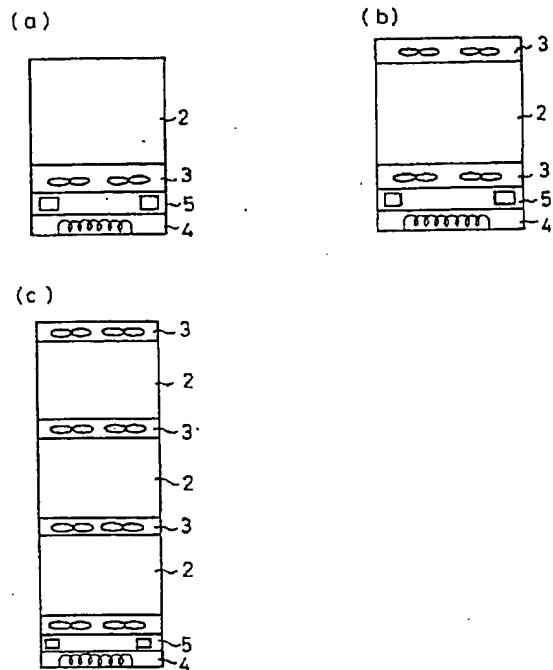
## 本発明の制御ブロック図



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本発明の他の実施例の側断面図



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CLAIMS

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[Claim(s)]

[Claim 1] By the fan unit (3) installed in the housing (2) which held electronic equipment (1) in the cooling system by the forced convection constituted so that the air which introduced the open air into the interior of a housing from the lower part of a housing, cooled generation of heat of electronic equipment, and got warm might be discharged from the housing upper part. Cooling system of the electronic equipment which installs a heating unit (4) and a humidification unit (5) in the open air introduction path of the housing lower part, and is characterized by reducing air temperature within the tolerance limit of relative humidity by evaporation of the moisture sprayed into the open air introduced.

[Claim 2] Cooling system according to claim 1 with which the aforementioned fan unit (3) is installed in the lower part of a housing (2).

[Claim 3] Cooling system according to claim 1 with which the aforementioned fan unit (3) is installed in the upper part of a housing (2).

[Claim 4] Cooling system according to claim 1 with which the aforementioned fan unit (3) is installed in the upper part and the lower part of a housing (2).

[Claim 5] Cooling system given in any 1 term of the claims 1-4 by which the laminating of the aforementioned housing (2) is carried out to multi-stage, and the aforementioned heating unit (4) and the humidification unit (5) are installed in the housing (2) of the bottom.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to the new cooling system of high-speed digital electronic equipment with the large calorific value per unit volume.

[0002]

[Description of the Prior Art] With increase of calorific value, cooling of electronic equipment shifts to the water-cooled method by contact to the cold plate which made the interior circulate through the coolant further to the forced-convection method by the fan from the thing using the free convection in a device, and, recently, the immersion-fluid cold method which dips a device into the coolant is adopted. Since the increase in an installation cost is caused and reliability moreover is not established as a system, such a water-cooled method and a liquid cooling method have still come [ however, ] to be adopted extensively. Therefore, now, the forced-convection method using the fan is the mainstream of cooling from it being reliable and an installation cost being cheap.

[0003]

[Problem(s) to be Solved by the Invention] this invention offers the cooling system which can perform still more efficient cooling, without changing the facility by the conventional forced convection sharply for the purpose of improvement of the cooling system of the electronic equipment by such forced convection.

[0004]

[Means for Solving the Problem] This purpose by the fan unit installed in the housing which held electronic equipment In the cooling system by the forced convection constituted so that the air which introduced the open air into the interior of a housing from the lower part of a housing, cooled generation of heat of electronic equipment, and got warm might be discharged from the housing upper part A heating unit and a humidification unit are installed in the open air introduction path of the housing lower part, and it is attained by the cooling system of the electronic equipment characterized by reducing air temperature within the tolerance limit of relative humidity by evaporation of the moisture sprayed into the open air introduced.

[0005]

[Function] The open air introduced into the interior of a housing lower shell by the operation of a fan unit is first raised by the heating unit within a tolerance limit in the temperature. Subsequently, moisture is sprayed by the humidification unit into this open air as a particle. This moisture particle absorbs the heat of air and reduces the temperature while it evaporates immediately in the air which carried out the temperature up and makes the relative humidity of air increase. In that case, the increase in the relative humidity by evaporation of the temperature rise by heating and moisture is adjusted so that it may become within an environmental tolerance limit.

[0006] In this way, cooling of electronic equipment is efficiently performed using the introductory air to which temperature fell. Hereafter, the suitable example shown in a drawing explains this invention still in detail.

[0007]

[Example] The principle of this invention is explained based on drawing 1 -3. The basic composition of this invention is as being shown in drawing 1 and 2, the fan unit 3 is installed in the upper part of a housing 2 which arranged in parallel and held the electronic-circuitry package 1 which constitutes electronic equipment, and the laminating and installation of the heating unit 4 which built heater 4a in the lower part, and the humidification unit 5 which built in supersonic-humidifier 5a are done. In a sign 6, in drawing, the water supply pipe for supplying water to the humidification unit 5 and 7 show a sensor.

[0008] If this electronic equipment operates, since a lot of heat will occur from LSI mounted in the electronic-circuitry package 1 and the temperature in a housing will be raised. The aforementioned fan unit 3 is operated, air is attracted up, the convection current is compulsorily formed in a housing, the cold indoor open air currently adjusted to predetermined temperature and humidity by the air-conditioner through opening of the housing lower part is introduced, the gap of electronic-circuitry package 1 comrades is passed, and this is cooled. And the air which got warm is emitted outside through the fan unit 1.

[0009] In this invention, the air introduced into the interior of a housing lower shell has the feature at the point that the temperature and humidity are readjusted, by passing the aforementioned heating unit 4 and the humidification unit 5 beforehand. In the psychrometric chart of drawing 3, the indoor environment in which electronic equipment is installed is adjusted considering the range of the temperature of 15 degrees C - 30 degrees C, and 40% - 60% of relative humidity as tolerance.

[0010] On the other hand, the permissible maximum temperature to the electronic parts mounted in the electronic-circuitry package 1 is 55 degrees C, and, in the case of the severest conditions, the difference of indoor air and a part permissible maximum temperature is  $= (55 - 30)$  25 degree C in the conventional cooling system. The difference of this enthalpy is about 6.5kcal/kg. This is heated by the heating unit 4 to 30 degrees C which is the upper limit of environmental temperature at the same time it takes in the indoor air adjusted to the temperature of 25 degrees C and 50% of relative humidity which are the case of this invention, for example, reference condition, inside the lower shell of a housing 2. Next, if moisture is sprayed into this air by the humidification unit 5, this will evaporate immediately, temperature will fall to 30 degrees C or less, and relative humidity will increase simultaneously. In this case, it is required to make it not exceed 60% whose relative humidity which controlled the amount of spraying of the moisture by the humidification unit 5 by the control system as shown in drawing 4, and rose in the relation with temperature with it is the upper limits of environmental humidity.

[0011] Thus, by cooling electronic equipment by humidification using the air which fell rather than 30 degrees C which is the upper limit of environmental temperature, the difference of about 7.9kcal [kg] enthalpy is acquired to air with a tolerance temperature of 55 degrees C, and it becomes elevation of about 20% of refrigeration capacity from the conventional method. Furthermore, the accompanying effect that generating of static electricity and generating of dust also decrease for humidification is also produced.

[0012] It only humidifies without operating the heating unit 4, when the interior of a room has already reached 30 degrees C which is the upper limit of environmental temperature for failure of air-conditioning equipment etc. Then, by evaporation of moisture, air temperature can fall and electronic equipment can be ventilated in low-temperature air like the above-mentioned. Drawing 5 (a), (b), and (c) show the composition of other examples of this invention.

[0013]

[Effect of the Invention] Since according to this invention indoor air was readjusted and the difference of the enthalpy to low temperature, nothing, with tolerance temperature was increased more by taking in within the limitation of the environmental temperature and humidity by the air conditioner, and performing humidification and heating to air as explained in full detail above, it becomes possible to cool more effective electronic equipment.

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TECHNICAL FIELD

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PRIOR ART

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EFFECT OF THE INVENTION

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TECHNICAL PROBLEM

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MEANS

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OPERATION

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[Function] The open air introduced into the interior of a housing lower shell by the operation of a fan unit is first raised by the heating unit within a tolerance limit in the temperature. Subsequently, moisture is sprayed by the humidification unit into this open air as a particle. This moisture particle absorbs the heat of air and reduces the temperature while it evaporates immediately in the air which carried out the temperature up and makes the relative humidity of air increase. In that case, the increase in the relative humidity by evaporation of the temperature rise by heating and moisture is adjusted so that it may become within an environmental tolerance limit.

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## EXAMPLE

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[0013]

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the perspective diagram showing the composition of the 1st example of this invention.

[Drawing 2] Similarly it is a sectional side elevation.

[Drawing 3] It is the psychrometric chart showing the principle of this invention.

[Drawing 4] It is the control-block view of this invention.

[Drawing 5] It is the sectional side elevation of other examples of this invention.

[Description of Notations]

1 -- Electronic-circuitry package

2 -- Housing

3 -- Fan unit

4 -- Heating unit

4a -- Heater

5 -- Humidification unit

5a -- Supersonic humidifier

6 -- Water supply pipe

7 -- Sensor

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2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

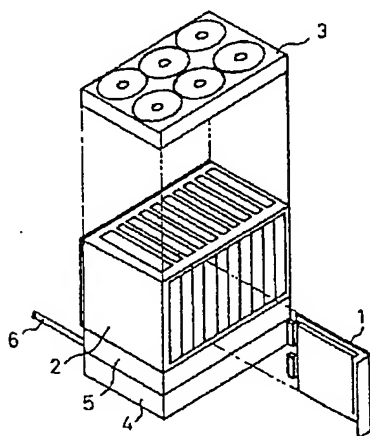
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DRAWINGS

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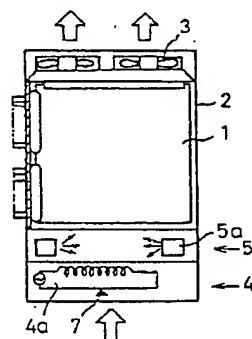
[Drawing 1]

本発明の第1実施例の構成を示す斜視図



[Drawing 2]

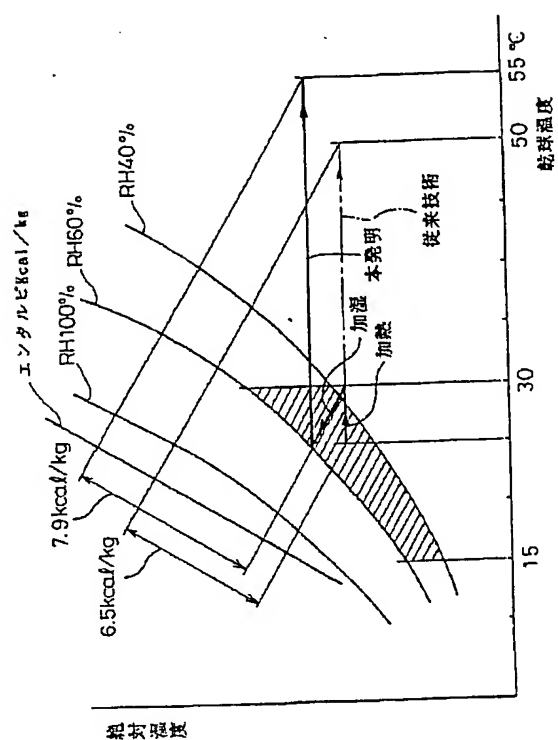
本発明の第1実施例の側断面図



[Drawing 3]

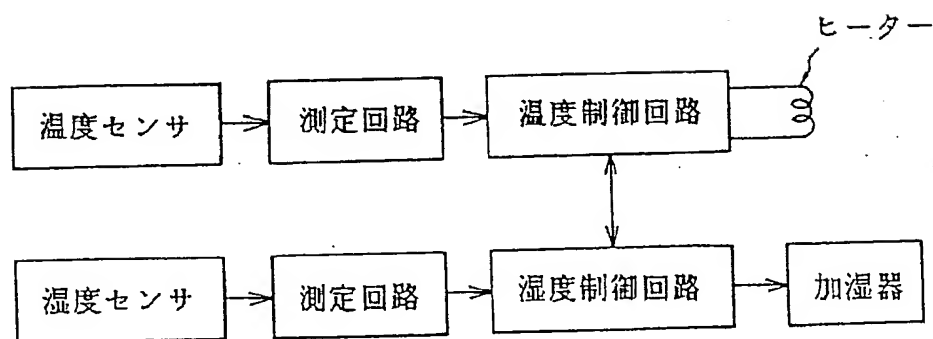


本発明の原理を示す空気線図



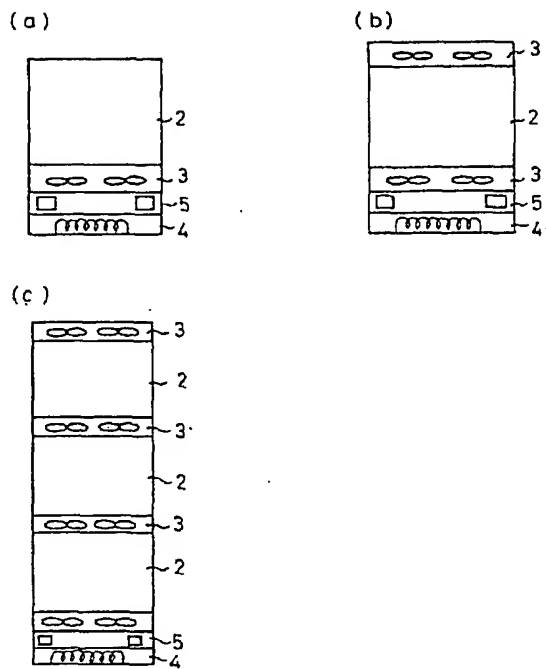
[Drawing 4]

本発明の制御ブロック図



[Drawing 5]

本発明の他の実施例の側断面図



[Translation done.]